

LAND CAPABILITY CLASSIFICATION OF UNIVERSITY OF AGRICULTURAL SCIENCES CAMPUS, RAICHUR DISTRICT OF KARNATAKA

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ABSTRACT

A study was conducted on Land Capability Classification in University of Agricultural Sciences campus, Raichur and found that the majority of the plots have the slopes ranging from 0 to 1.35 percent it indicates that the soils are less susceptible for erosion and suitable for cultivation. According to soil fertility data, majority of plots comes under Alkali soils thus concluded that suitable for cultivation. The infiltration rates in selected nine plots were in the range of 0.57 to 1.35 cm hr⁻¹ indicating the soils were low to medium infiltration rates. The land use capability classification for the area is under two classes of III_e and III_{es}. The total of 164 plots comes under III_e, i.e. moderately susceptible for erosion and 52 plots comes under III_{es} which is susceptible for moderate to severe erosion, hence it requires soil conservation measures such as contour and lateral bunds followed by waste weirs and adequate supply of fertilizers and organic manures.

KEYWORDS: Infiltration Rate, Land Capability Classification, Land Use Pattern, Slope

INTRODUCTION

India is a country of splendid diversity of soil, climate, food, clothing and culture. The stability in the sector of food security, fiber and shelter provisions and animal wealth has been threatened due to ever-increasing population pressure and indiscriminatory use of land resources leads to decline of soil productivity and ultimately to poorer quality of life (Velayuthamet *et al.*, 2011). Though India has overcome the situation of food shortage and increased its production from less than 100 million tons per year in the early sixties to 195 million tons per year in this decade, the goal of self sufficiency in the dynamic, socio-economic framework in a sustainable nature needs urgent attention and scientific guidance. This can be achieved through sustainable land management (Edward *et al.*, 1990). Agriculture in the Northern Karnataka has always been highly dependent on the traditional trilogy of rain fed crops, which are cotton, sunflower, sorghum and red gram resulting in a close relationship with the environment that overcomes local, regional and national borders. Improper management of dry-farming systems under these conditions would lead to break the existing balances, resources, demand and supply enhance erosion and land degradation and give rise to rural depopulation. The main objective of the study was preparation of land capability maps containing technical data related to soil survey helps in land use planning to make the best use of land resource in that scientific and technical information is ascertained for each class of land.

The Land Use Capability (LUC) Classification arranges the different kinds of land according to those properties that determine its capacity for long-term sustained production. Land productive capacity depends largely on the physical qualities of the land, soil and the environment. The limitations imposed by the physical qualities of the land, soil and the environment are erosion, steepness of slope, susceptibility to flooding, liability to wetness or drought, salinity, depth of

soil, soil texture, structure, nutrient supply and climate (<http://www.landcareresearch.co.nz>). Land capability, suitability and vocation have been used indistinctly to recommend the most appropriate land use for a given soil (Comerma, 2010). Land-use changes in farming areas that derive from declining of agricultural practices or even from frequently unreasonable overexploitation of water resources have led many semiarid regions of the world to boundary conditions demanding urgent strategies of water management towards sustainable development. Land is the most valuable natural resource, which needs to be harnessed according to its potential (Sachin, 2011). When land is put to certain uses, there is an accompanying change in the intrinsic properties of the soil and this alters the hydrological balance of the soil (Osujiet *al.*, 2010). Better land management involves identifying land-use changes, understanding current land-use patterns or features, assessing economic and ecological benefits and costs that arise from land-use practices as well as finding the best alternatives for each area.

MATERIALS AND METHODS

Raichur is located at 16° 21' N latitude, 76° 24' E longitude and 389.5 m above mean sea level. The climate is semi arid. The region is characterised by mean annual rainfall of 687.7 mm, day temperature is high, high sun shine hours, low humidity and excessive evaporation during the summer season. The UAS Raichur campus spreads over an area of 241 ha. The campus area is divided into two main blocks namely, old block (138 ha) and new block (103 ha). The old block is bound by state highway no. 20 in east-west direction, village cart road connecting Askihal village to Rampur village in north-south direction and municipal road connecting Raichur town to Rampur village. It mainly consists of buildings of Agricultural College, College of Agricultural Engineering, Main Agricultural Research Station (MARS), KrishiVignana Kendra (KVK), residential complex, auditoriums, library, hostels, play ground and roads apart from agricultural field plots. Further, the old block consists of field plots numbered from 1 to 116 and the area of each plot ranged from 0.20 to 1.0 ha. The college complexes and roads occupied an area of 47 ha. The residential complex consists of staff quarters, amenity buildings, guest houses, hospital, boys' and girls' hostels, farmstead area, animal shed barn, farm buildings, godowns, tractor sheds etc. The area of the orchards is 31.62 ha and the farm ponds/fish ponds occupied an area of 10.57 ha. The new block (103.0 ha) consists of exclusively agricultural field plots numbered from 117 to 233, the areas of which range from 0.20 to 1.0 ha. The new block is bound by Askihal village boundary in north and Rampur village in south and east.

Soil Profile Characteristics for Land Capability Classification

The land capability classes range from the best and most easily cultivated land to which may have severe limitations for cultivation, grazing or forestry, but is suitable for other non-agricultural purpose. The important soil profile characteristics which are interpreted for classifying lands under different land capability classes are soil texture, effective soil depth and hard pan, permeability and internal drainage, availability of nutrients, coarse soil fragments and soil problems such as salinity, alkalinity and toxicity.

Climate

The data on climatic parameters as rainfall (mm), maximum and minimum temperature ($^{\circ}\text{C}$) and relative humidity (per cent) recorded at meteorological observatory of the MARS in the campus were collected and used. The data revealed that mean annual rainfall of last 30 years was 700.01 mm and October month received mean maximum rainfall of 154.6 mm. The mean maximum temperature varied from 30.3 $^{\circ}\text{C}$ in December to 40.6 $^{\circ}\text{C}$ in May, while the minimum temperature ranged from 15.7 $^{\circ}\text{C}$ in December to 25.3 $^{\circ}\text{C}$ in May. The April and May months are hottest months and December and

January are the cold months. The mean relative humidity fluctuated from 37.5 per cent in March to 69.1 per cent during August.

Soil Type

The hydrologic soil group of the Raichur campus consisting of the *vertisols* are 2 to 3 m deep black soils and are mainly seen in the old block and available moisture holding capacity ranged from 65 to 70 per cent. Similarly *alfisols* are mostly found in new blocks which are basically shallow (0.7 to 1.0 m) and their available moisture holding capacity was in the range of 30 to 35 per cent. The moisture contents at field capacity and wilting point were determined by taking soil samples at different pockets in both the soils and by gravimetric method. The random soil samples from field plots were collected and analyzed to determine their physico-chemical properties. To make *alfisols* more productive, management practices should be used that increase infiltration and thereby, the amount of water that is available for use by crops (Rao *et al.*, 1998)

The black soil is clay in texture, alkaline in reaction (pH 8.16), low in soluble salt content (EC 0.3 dSm⁻¹) and medium in organic carbon content (OC) 0.53 per cent. The cation exchange capacity of soil was 53.91 c mol (p⁺) kg⁻¹. Available K₂O content of soil was 1272 kg ha⁻¹. Exchangeable Ca²⁺ and Mg²⁺ contents of soil were 40.2 and 11.86 c mol (p⁺) kg⁻¹ respectively.

The red soil is sandy clay loam in texture, alkaline in reaction (pH 8.08), low in soluble salt content (EC 0.2 dsm⁻¹) and low in organic carbon content (OC 0.49 per cent). The cation exchange capacity of soil was 15.13 c mol (p⁺) kg⁻¹. Available K₂O content of soil was 744 kg ha⁻¹. Exchangeable Ca²⁺ and Mg²⁺ contents of soil were 15.8 and 3.72 c mol (p⁺) kg⁻¹ respectively.

Land Use Pattern

In the campus, apart from the land used for agriculture, horticulture, agro-forestry, and allied activities such as animal husbandry and fisheries, there is considerable area occupied by the building complexes of the colleges, offices and residential quarters, sports field, roads etc. The area under agriculture and horticulture were 130.93 and 27.50 ha respectively, area under agro-forestry was 25 ha. The areas under rainfed agriculture and protective irrigation were 73.93 and 84.50 ha respectively.

The details of the cropping pattern followed in the UAS campus, Raichur during the investigation period were sunflower, castor, groundnut, fodder, linseed, niger, sesame in kharif season. During rabi season the crops were safflower, groundnut, sorghum, chickpea and horticulture crops were mango, sapota, guava, fig, citrus, vegetables etc.

Determination of Infiltration Rates

Infiltration rates of selected nine locations (plot no's: 128, 136, 143, 151, 158, 169, 180, 193, 204) were measured using double ring infiltrometer. The double ring infiltrometer consists of two feeding tanks, two concentric rings and an angle frame work for mounting the feeding tanks.

Installation and Observations of Constant head Double Ring Infiltrimeter

The cylinders are usually about 25 cm deep and are formed of 2 mm rolled steel. The inner cylinder, from which the infiltration measurements are taken, is usually 30 cm in diameter. The outer cylinder, which is used to form the buffer pond, is about 60 cm in diameter. The cylinders are installed about 10 cm deep in the soil. This is accomplished by marking the outside of cylinders at 10 cm level and driving the cylinders up to the mark. The cylinders are driven into the

ground by falling weight type hammer striking on a wooden plank placed on the top of the cylinder or by light blows with an ordinary hammer and using a short wooden plank to prevent damage to the edges of the metal cylinder.

The water level in the inner cylinder is read with a field type point gauge or hook gauge. The point rod is set at the desired level to which water is to be added. Water is added to the inner cylinder from a container of known volume and a graduated jar. It is added by pouring on to a piece of folded jute matting. The matting is used to prevent puddling and sealing of the surface soil. After filling the cylinder to about three-fourths of the desired level the matting is removed.

A stop watch was used to note the instant of the time of addition of water begins and the time, the water reaches to the desired level. The total quantity of water added to the inner cylinder is determined by counting the number of full containers added last. Care was taken to fill the container completely each time before adding water to the cylinder. The difference between the quantity of water added and the volume of water in the cylinder at the instant it reached the desired point was taken as the quantity of water that infiltrates during the time interval between the start of filling and the first measurement.

After the initial reading, point gauge measurements are made frequent intervals to determine the amount of water that has infiltrated during the time interval. Water was added quickly after each measurement so that a constant average infiltration head could be maintained. Point gauge readings are taken before the water level recedes more than 1 cm. The average depth of water maintained in the cylinder was 7 to 12 cm, which was approximately equal to the water level expected in the irrigation border or basin during irrigation. The buffer pond was filled with water immediately after filling the cylinder and the buffer pond were kept approximately the same. The experiments were continued beyond the estimated time the water would stand in borders or basins during irrigation (Michael *et al.*, 2008). The observed basic infiltration was considered has the infiltration capacity of the soils and classified the soils based on infiltration rates by very low (below 0.25 cm/hr), low (0.25 to 1.25 cm/hr), medium (1.25 to 2.50 cm/hr) and high (above 2.50 cm/hr) (Gurmelet *et al.*, 1990).

RESULTS AND DISCUSSIONS

Soil Types and their Potential

The UAS campus old block predominantly consists of *vertisols* with a soil depth of 2 to 3 m, are best suited for bi-seasonal crops like cotton and pigeon pea under rainfed conditions. The analysis of soil properties showed that the soils are slightly alkaline in reaction but the salinity is within the limits ($EC < 0.3 \text{ dSm}^{-1}$). However, certain pockets in lower reach (10.80 ha) are salt-affected due to improper drainage conditions. These soils if subjected to intensive irrigation would be affected by water logging and salinity and therefore, require proper drainage. For normal soils, good surface drains are needed for disposal of excess runoff to prevent soil erosion, accumulation and stagnation of water. Available nitrogen (246.4 kg ha^{-1}) indicates that the root zone has low to medium nitrogen availability, whereas phosphorus (P_2O_5) 64.12 kg ha^{-1} and potassium (K_2O) $1,272 \text{ kg ha}^{-1}$ are at satisfactory levels. This shows nitrogen has been consumed over the seasons by the crops substantially and the soils require external nitrogen input through suitable chemical fertilisers. There is no much depletion in P and K nutrient contents. Farm managers generally plan bi-seasonal crops for this area on rotation in order to maintain the fertility status. However, during the drought years, in order to facilitate and strengthen the specified research programmes, protective irrigation is required invariably. As the available moisture holding capacity ranged between 30 and 35 per cent, the irrigation interval can be maintained between 10 and 15 days. The susceptibility to sheet erosion can be reduced by constructing contour and lateral bunds followed by waste weirs wherever required. These conservation practices would also help in soil moisture improvement. The new block mainly consists of *alfisols* (sandy clay

loam to sandy loam) with land slope in the range of 0 to 1.35 per cent. These soils are slightly alkaline in reaction with low soluble salt content ($EC < 0.27 \text{ dSm}^{-1}$). While the nitrogen status is low (134.4 kg ha^{-1}), the levels of P_2O_5 (27.49 kg ha^{-1}) and K_2O (744 kg ha^{-1}) are satisfactory. These soils (*TypicHaplustals*) belong to land capability class of III and hence are suitable for irrigation without the problems of land degradation in respect of water logging and salinity. However, as heavy rains in short bursts are common during the monsoon season, surface drainage is needed to dispose excess runoff.

Land Slope

Land slopes of old and new area are measured with the help of dumpy level. In old area slope varies between 0 to 1 per cent. Majority of plots slope ranges between 0 to 0.5 per cent. In new area slope varies between 0 to 1.35 per cent. Majority of the plots slope ranges between 0 to 0.62 per cent.

Infiltration Rates

The infiltration rate observed in selected nine plots from beginning to end was in the range of 17.5 cm hr^{-1} to 0.57 cm hr^{-1} . In plot no-128 the infiltration rate at beginning was observed to be 16.32 cm/hr and at end was 1.35 cm/hr , indicating that infiltration capacity is falling under medium infiltration rate. In remaining eight plots the infiltration capacity were in the range of 17.5 cm hr^{-1} to 0.57 cm hr^{-1} indicating that infiltration capacity is falling under low infiltration rate (Table 1).

Land Use Pattern

The areas under agriculture, horticulture, agro-forestry, forage crops and fisheries (farm ponds) are 130.93, 27.50, 25, 10 and 10.57 ha respectively. While the area under the protective irrigation is 84.50 ha , the same under rainfed farming is 73.93 ha . The area under gravity irrigation is 74.50 ha against only 10 ha under micro irrigation. Thus, there is a vast scope to bring more area under protective irrigation especially using drip and sprinkler irrigation to carry out the research programmes or cultivating other crops successfully to enhance the farm productivity and production leading to higher economic returns.

Land Capability Class III_e and III_{es}

The land capability class III_e has been covered by sandy clay loam soil and soil depth ranging between 0.7 to 1 m. The land has slope class nearly level (0 to 1.35 per cent). The observed soil pH (6.16 to 9.46) and EC (0.1 to 1.8 dSm^{-1}) at the depth of 0 to 15 cm soil pH value (5.5 to 9.89) and EC (0.05 to 1.8 dSm^{-1}) at the depth of 15 to 30 cm, value indicate that the soils are saline sodic. The soils in this capability class are moderately well drained with soil gravelliness of less than 15 per cent and susceptible to moderate erosion (Figure 1).

The land capability class III_{es} has been covered by clay loam soil and soil depth ranging between 2 to 3 m. The moisture retention capacity of the soils (vertisols) is comparatively high due to its heavy texture. The land has slope class very gentle to gentle sloping (0 to 1 per cent). The observed soil pH and EC were ranging between 8.34 to 9.1 and 0.59 to 0.77 dSm^{-1} respectively. The higher value of soil pH and the lower value of EC have a definite effect on soil physical properties in terms of reduced air and water movement and also affecting adversely their availability of plant nutrients owing to higher level exchangeable sodium, this reduced water movement in the soil has increased the water level in the area and thereby the soluble salts have reached the surface as a result of capillary action during the severe summer months. The moisture in the surface layer of soil is lost to the atmosphere due to evaporation and the moisture from the

lower layers rises to the surface through capillary action and as a result, brings the salt from the lower layers of the soils to the surface. This leaves the high salt concentration in the surface layers in due course of time. This has led to the built up soil salinity in the surface soil layers. The soils in this capability class are moderately well drained to well drained with soil gravelliness of less than 15 per cent and susceptible for moderate to severe erosion (Figure 1).

CONCLUSIONS

The Land Capability Classification was made for the University of Agricultural Sciences campus, Raichur based on soil, climate and land use pattern. Regarding the land slopes majority of the plots ranging from 0 to 0.5% which indicates that the soils are less susceptible to erosion and suitable for cultivation. By using Double Ring Infiltrometer, the infiltration rates for the selected nine plots were ranging between 0.57 to 1.35 cm/hr, indicating the soils were low to medium infiltration rates. According to soil fertility data, majority of plots comes under Alkali soils ($\text{pH} > 8.5$, $\text{EC} < 1.8$ ds/m) thus concluded that suitable for cultivation. The classification for the area is under two classes of III_e and III_{es} . The total of 164 plots comes under III_e , i.e. moderately susceptible for erosion and 52 plots comes under III_{es} which is susceptible for moderate to severe erosion.

Table 1: Infiltration Rates (cm hr^{-1}) of Selected Plots of UAS Campus, Raichur

Time (Min)	Plot Numbers								
	128	136	143	151	158	169	180	193	204
2	16.32	17.50	13.50	13.50	14.20	13.5	16.94	15.00	16.50
4	11.43	12.88	9.45	7.25	10.22	6.00	12.50	10.55	12.33
6	7.20	8.96	5.98	4.20	6.65	3.05	8.04	5.89	7.65
8	4.46	5.65	3.87	2.52	4.20	1.95	4.88	3.34	4.32
10	2.76	3.43	2.54	1.95	2.52	1.25	2.69	2.24	2.78
15	2.00	2.16	1.67	1.53	1.55	0.95	1.85	1.67	1.87
20	1.56	1.35	1.39	1.20	1.02	0.90	1.50	1.61	1.54
25	1.54	1.05	1.28	1.03	0.92	0.85	1.43	1.57	1.41
30	1.52	1.03	1.25	0.95	0.89	0.80	1.39	1.55	1.39
40	1.49	0.99	1.21	0.93	0.86	0.75	1.35	1.51	1.37
50	1.47	0.95	1.18	0.84	0.83	0.71	1.28	1.49	1.35
60	1.46	0.93	1.15	0.82	0.82	0.70	1.25	1.47	1.34
75	1.45	0.92	1.12	0.76	0.79	0.70	1.21	1.46	1.32
90	1.45	0.91	1.09	0.73	0.75	0.69	1.17	1.39	1.29
120	1.44	0.90	1.06	0.68	0.71	0.69	1.13	1.34	1.27
150	1.43	0.89	1.03	0.67	0.69	0.69	1.09	1.31	1.25
180	1.429	0.88	1.00	0.65	0.67	0.69	1.03	1.28	1.24
240	1.41	0.87	0.97	0.64	0.66	0.68	0.98	1.25	1.23
300	1.39	0.86	0.95	0.59	0.64	0.68	0.95	1.22	1.22
360	1.38	0.857	0.91	0.57	0.61	0.68	0.88	1.19	1.19
420	1.35	0.854	0.84	0.57	0.59	0.68	0.88	1.15	1.187
480	1.35	0.851	0.84	0.57	0.59	0.68	0.88	1.15	1.187
540	1.35	0.849	0.84	0.00	0.59	0.00	0.00	1.15	1.187

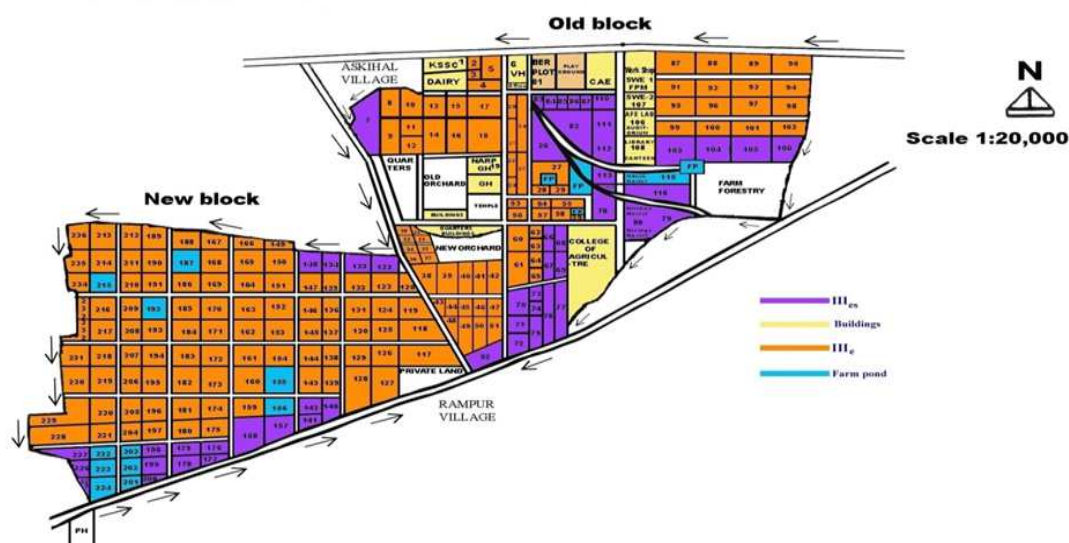


Figure 1: Map Showing Land Use Classification of UAS Campus, Raichur

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